APPENDIX F-3

PHILADELPHIA INTERNATIONAL AIRPORT INVENTORY AND METHODOLOGY

Bureau of Air Quality
Department of Environmental Protection
Division of Air Information

I. <u>Including Airport Emissions into the SIP – A Background</u>

A. A Brief Overview of the Philadelphia International Airport

The Philadelphia International Airport (PHL) is an integral part of the economic engine that both drives growth and responds to growth in the 5-county Philadelphia region and beyond. The Federal Aviation Administration (FAA) has designated PHL as a large hub airport. Large hub airports are defined as commercial service airports that account for greater than one percent of total U.S. passenger enplanements.
PHL serves 26 scheduled passenger airlines, six cargo airlines, and general aviation. PHL serves as a domestic connecting hub and international gateway for US Airways and is a cargo hub for United Parcel Service. In 2002, PHL was ranked the 12th busiest airport in the United States in terms of aircraft operations.

The airport has been incrementally expanded and improved since it opened in 1940. The most recent improvements include the construction of Runway 8-26 in 1999 and the new International Terminal A-West in 2003. FAA recently approved an extension of Runway 17-35 which is a project designed to immediately reduce current delays. Despite completing most of these projects designed to lessen delays, PHL was rated the fifth most delayed airport in the U.S. The FAA identified PHL as one of the airports that contributes significantly to delays throughout the national airport system. In 2000, the City of Philadelphia initiated a Master Plan Update to study the facility needs of the airport to meet future demand. The Master Plan Update projected that the duration of the average annual delay per operation at PHL would increase from its current level of nearly 10 minutes to nearly 19 minutes with the current airport configuration. The total number of delayed operations would also increase.

The City's master plan consultants studied the delay times and developed possible remedies or alternatives. The Master Plan Update concluded that the current and projected delays needed to be reduced as soon as possible. The major long-term project proposed for reducing delay is known as the Capacity Enhancement Program (CEP). The CEP is proposed to be a significant redesign of the airport's runway system, taxiways, and renewal of the terminals. The CEP alternatives under consideration strive to lower delay times, particularly during bad weather conditions. The primary way this will be accomplished would be to create more separation between runway configurations than exist now. This will enable multiple aircraft operations to occur simultaneously on at least two parallel runways during bad weather. The revised runway configuration would also be accompanied by a more efficient taxiway system. To construct the new airport layout would require a massive excavation and earth moving effort. The construction emissions as well as project related aircraft emissions may generate significant emissions of NOx.

The air quality effects of certain federally funded projects, that generate large amounts of direct or indirect emissions in non-attainment and maintenance areas, such as the CEP, are required to be analyzed extensively. State and federal general conformity regulations require it. The primary concern being that these large projects may add enough emissions to cause or contribute to a violation of a National Ambient Air Quality Standard. An environmental impact statement (EIS) always accompanies a major FAA action such as the PHL CEP. Results from the EIS often serve as a basis for developing a general conformity determination. Specifically, general conformity is designed to ensure that a federal action will not produce emissions of a criteria pollutant that will:

- Cause or contribute to new violations of the National Ambient Air Quality Standards (NAAQS)
- Increase the frequency or severity of existing violations of the NAAQS, or
- Delay the timely attainment of any NAAQS or any required interim emissions reductions or milestones.

B. General Conformity

The Department of Environmental Protection adopted by reference in *Pa Code*, Title 25, Subchapter J the federal requirements contained in Determining Conformity of General Federal Actions to State or Federal Implementation Plans (40 CFR, Part 93, Subpart B). General conformity guides the Department in how to address emissions from all other federal actions not covered by 40 CFR, Part 93, Subpart B – Determining Conformity of General Federal Actions to State or Federal Implementation Plans. General conformity requires the federal agency taking an action, such as FAA approval of the CEP, to develop a general conformity determination for each applicable pollutant to determine that the total direct and indirect emissions in a non-attainment or maintenance area would not exceed specified rates outlined in the general conformity regulation. Since PHL is in the Philadelphia-Wilmington-Atlantic City Non-Attainment Area for ozone, general conformity requires that no federally funded project can emit a specific amount of ozone precursors, which includes oxides of nitrogen (NOx) and volatile organic compounds (VOC), during the calendar year that the project takes place. Currently, the total of direct and indirect emissions from federal actions may not exceed 100 tons per year of either NOx or VOC in the Philadelphia-Wilmington-Atlantic City Non-Attainment Area.

In formulating its plans for attaining and maintaining the ambient standards, the Department needs to have a clear reference point in knowing how much potential additional emissions would be generated from a large project like the CEP. When a project subject to general conformity exceeds the applicable emission, the indirect and direct emissions that are produced as a result of the project need to be entirely offset either through reducing the indirect or direct emissions, the development of additional mitigation measures in the non-attainment area, purchase of emission reduction credits, or a determination needs to be made that the emissions are included in the air quality State Implementation Plan (SIP). A combination of the aforementioned emission reduction methods could also be fashioned.

C. Air Emissions from the CEP

An air quality analysis will be included in the EIS for the CEP. The air quality analysis is prepared in accordance with National Environmental Policy Act (NEPA) requirements. Part of the air quality analysis will include an emission inventory analysis of the relevant criteria pollutants.

For the general conformity regulation, emissions generated at PHL are estimated using two different scenarios. One scenario is the build scenario, which estimates the amount of emissions produced if the project is developed. The other scenario is the no-build scenario, which estimates the amount of emissions that would be produced if the airport continues on a business-as-usual course without building the CEP. As stated, the CEP will reduce delay. Reduced delay will greatly reduce emissions since aircraft taxi and queue times will diminish. Even though the new airport will accommodate more operations, the emissions generated after the airport is redesigned could be projected to be less than if the airport is operated without the improvements from the CEP in the future. In other words, the average delay times will be reduced such that they offset most, if not all, emissions from the extra operations accommodated by the proposed project.

However, the CEP could generate a significant amount of emissions during construction. Increased emissions from less efficient aircraft operations efficiencies and the resulting increased delays probably would combine with construction emissions during years of construction. Aircraft operations during construction are anticipated to be less efficient primarily because fewer runways will be available at various points in time during the construction.

D. Cooperative Effort Launched to Include PHL Emissions in the SIP

Detailed inventories of the operations and emissions at PHL were developed. The Department worked closely with the City of Philadelphia, Division of Aviation, and their consultants (DMJM Aviation and Jacobs Consultancy, formerly known as Leigh-Fisher Associates) in a workgroup for several years in order to comprehensively describe and document the emissions from PHL in the ozone SIP for the years 2002 and 2009. The airport workgroup strove to bring together all of the emissions from sources at PHL into a detailed inventory of emissions. A detailed inventory will meet two goals: 1) an inventory will allow the Department to determine what emissions are included in the SIP in order for the airport to best develop a mitigation strategy for a project and 2) this will allow the airport to be eligible for Voluntary Airport Low Emissions (VALE) Funding.

In addition, the FAA has undertaken an Environmental Impact Statement for the CEP, where the Department and the U.S. EPA have been actively engaged.

II. Emissions Inventory Development Methodology

A. Inventory Modeling

1. Modeling Project

Emissions at PHL for 2002 and 2009 calendar year and ozone summer weekday were modeled using historic data and the most current forecast current data available. In addition, the Department is federally required to develop and include in the SIP a milestone emissions inventory for 2008 summer weekday emissions. Using a straight-line interpolation between the emissions estimated in 2002 and 2009 produced the milestone emissions inventory for 2008 for all airport emissions. As stated, the department worked closely with the City of Philadelphia, the city's Division of Aviation, and consultants to PHL to incorporate representative activity levels at PHL in all of the required emissions inventory modeling.

2. Emission Dispersion Modeling System (EDMS)

EDMS is the EPA-approved model that the Department used for developing emissions inventories for aircraft, ground support equipment, and auxiliary power units. The FAA and the U.S. Air Force developed EDMS. The most current version of EDMS available when the inventory was developed, EDMS 4.5, was used when the emissions inventory was developed.

3. Mixing Height Used for Modeling PHL

Mixing height is the altitude under which ozone precursors (NOx and VOC) mix to form ozone. A more accurate mixing height than the presumed default value in EDMS was used developing an inventory for PHL. Upper air meteorological data available from Sterling, Virginia in combination with surface data measurements taken at the PHL generated 1-hr mixing heights in the meteorological preprocessor model PCRAMMET, EPA, *PCRAMMET* (software), Research Triangle Park, NC, June 1999. All mixing heights between 10 p.m. and 6 a.m. were not considered when generating these averages because a small percentage of flight operations occur between those hours. The average summer weekday mixing height was estimated to be 4,428 feet for PHL. The average annual daily mixing height was estimated to be 3,600 feet.

4. Estimating Emissions Not Related to Aircraft

Other types of emissions sources exist at PHL such as highway motor vehicles, point, area, and nonroad sources. The Department developed an emissions inventory of these sources. In some cases, when emissions from an area were included in the regional SIP inventory, the Department separated the emissions and included them in the emissions estimates of the airport section. In other cases, for instance, motor vehicles, emissions on

PHL property were not originally included in the regional SIP inventory and were added to the regional inventory as well as the airport inventory.

B. Aircraft

Commercial aircraft operations were significant and were modeled by the EDMS 4.5 model directly. Emissions from aircraft operations were the most significant source of emissions at the airport. Annual and ozone summer weekday emissions were modeled for both calendar years 2002 and 2009. Only annual emissions are considered for meeting general conformity requirements. At PHL, summer weekday emissions are typically greater than what would be experienced on a typical average annual day (annual emissions divided by 365 days).

1. PHL Operations Data

The Department obtained operational data for PHL that was more exact than any other airport that was modeled in Pennsylvania. Four sets of data were requested from the airport for this study, an average ozone season weekday and annual operations by aircraft type, or airframe for 2002 and 2009.

The airport's Noise and Operations Monitoring System (NOMS) provided the percent of total operations per aircraft type for both data sets. These percentages were applied to PHL aircraft activity data supplied by the FAA Air Traffic Control (FAA ATCT) tower at PHL. The aircraft activity data saved within the NOMS database consists of actual FAA radar supplied by the FAA ATCT to the airport as part of a Memorandum of Agreement (MOA). The MOA specifies that the airport collect aircraft radar data within 28 nautical miles radius of PHL up to 15,000 feet in altitude. All sensitive operations such as certain military operations are filtered and are not included in the inventory.

2. Average Ozone Season Week Day

The data consists of the daily average of all weekday (Monday through Friday) aircraft arrivals and departures on each runway at PHL for the months of July, August, and September 2002. A query of the NOMS database retrieved the aircraft operations that occurred for each of the three months for each aircraft type. The data was sorted by flight number in order to assign an aircraft type typical for that carrier and flight number. All operational unknowns were reconciled by comparing aircraft types common to a particular airline operator and flight number. Total number of operations per aircraft type for each month was totaled. The total number of operations for each aircraft type was then computed as a percent of total operations for each aircraft type for the three-month time period. The percentages were multiplied by the number of aircraft operations provide by the FAA ATCT to calculate the number of operations per aircraft type for an average ozone summer weekday. This number was divided by the number of weekdays in the ozone season to derive a summer ozone weekday average of operations per aircraft type.

3. Annual Operations

This data consists of all aircraft arrivals and departures to and from each runway at PHL for calendar year 2002. A query of the NOMS database retrieved the aircraft operations described above. The data was sorted to address all unknown aircraft types and flight numbers in order to assign an aircraft type common for that airline and flight number. Types of aircraft were assigned to unknowns when possible. Total number of aircraft operations per aircraft type for each month was then totaled for all 12 months. The total number of operations per aircraft type was estimated as a percent of total operations for each aircraft type for the 12-month time period. These percentages were multiplied by total annual aircraft operations provided by the FAA ATCT to calculate the number of annual operations per aircraft type.

4. Growing Operations To 2009

In connection with the PHL Master Plan, forecasts of aviation activity and passenger enplanements through 2020 have been prepared and documented in the *Philadelphia Master Plan Forecast Report.* The forecasts were prepared by Leigh Fisher Associates, which is now known as Jacobs Consultancy, for the City of Philadelphia. The forecasts were prepared based on FAA Advisory Circular 150/5070-6B Airport Master Plans and are also consistent with the FAA Terminal Area Forecast. The forecasts were prepared using a standard methodology, summarized as follows:

- Analysis of historical growth trends, and in particular historical growth in relation to key factors such as economic activity and airline service developments. Statistical analysis was conducted to examine the historical growth trends and provide input to assumptions regarding future growth trends.

- Assumptions regarding future annual growth rates using professional judgment based on analyses of historical trends and reference to independent forecasts such as the Federal Aviation Administration (FAA) forecasts for the nation as a whole.

- Assumptions regarding the likely future trend in key ratios such as average aircraft size and boarding load factors, based on analyses of recent actual activity, information on airline fleet developments, and reference to independent forecasts such as the FAA forecast for the nation as a whole.

The forecasts are unconstrained demand forecasts; that is, not dependent on the assumed availability of airport capacity. These forecasts were submitted to FAA by the City of Philadelphia for review and concurrence. These forecasts were considered reasonable by FAA and approved for use in the Master Plan as well as for the CEP EIS.

The analysis yielded total number of operations expected in 2009 along with the percentage breakdown of operations per aircraft type. The total operations per aircraft type were allocated to the various engine configurations and specific aircraft types in the same proportion that were used in developing the 2002 inventory.

The Department is required to show reasonable further progress in achieving necessary reductions in ozone precursors by 2008. A 2008 specific inventory was not developed for the SIP. Emissions of NOx and VOC were linearly interpolated between 2002 and 2009 to obtain 2008 emissions.

5. Aircraft Operations in EDMS

An operation is considered either a takeoff or a landing. Operations for each aircraft type were divided by two to obtain landing-and-takeoff (LTO) cycles for each aircraft. EDMS requires that the number of LTO cycles per aircraft type are entered in order to calculate emissions.

6. Engine Assignment

EDMS assigns a default engine to each aircraft type. The default engine was used unless better data was known. In some cases, it was known that certain airlines operate aircraft with certain engine models that are not the default engines listed in EDMS. The actual engine was assigned to an aircraft type when available. Aircraft that used non-default engines and were similarly reflected in the EDMS modeling were the Airbus 319, Airbus 320-211, Boeing 737-300, and the Boeing 757-200. See table titled "Comparison of Actual and EDMS Fleet Mixes and Engine Types 2002 Baseline Analysis" at the end of the appendix for further information.

7. Suitable Aircraft Substitutions

A few models of smaller aircraft were not included in EDMS. For those aircraft, a suitable substitute aircraft was used. A suitable substitute was usually an aircraft that used the exact or similar engine and the substitute aircraft had a similar weight to the actual aircraft. Aircraft that were not included in EDMS that had significant operations at PHL were the Lear 45, Lear 55, Lear 60, Mu-2 Marquise, and the B58 Baron. They were replaced by suitable substitutions Citation VII, IAI 1124 Westwind, Citation Sovereign, Jetstream 31, and Navajo. See table titled "EDMS Aircraft Recommended Substitutions PHL Master Plan SIP Assessment" at the end of this appendix for further information.

8. Ground Delay

The method for developing the delay times per LTO at PHL was described in detail by Jacobs Consultancy. In summary, the average taxi-out and average taxi-in times for each runway in the primary operating configurations, which are weather related, were taken from Appendix C of *Airport Master Plan Technical Report 2004.17, Runway 17-35 Extension, Capacity/Delay Simulation Analysis*, August 27, 2004. A weighted average based on meteorological conditions and specific aircraft types that use the airport's various runways during each operating configuration were developed. Two different delay times were developed for 2002. One delay estimate represented larger aircraft that primarily use the larger runways and the other represented smaller aircraft, such as general aviation and air taxi aircraft, which primarily use the shorter runways. In 2009, it was forecasted that the extension to runway 17-35 would equalize the delay times of all aircraft at the airport.

The EDMS model places taxi time, idle time, and delay time in a single Time-in-Mode category, reflecting the operation of aircraft with engines at very low throttle settings. This Time-in-Mode is not intended to include delay where an aircraft is not running the main engines (e.g. waiting out a delay at the gate). Table 1 presents Taxi/Idle/Delay Time-in-Mode used in the EDMS modeling that supported the SIP.

Table 1: Average Taxi/Idle/Delay Time-in-Mode per Landing and Take-Off Cycle at PHL

Year	Smaller Aircraft Delay	Larger Aircraft Delay
2002	15.32 minutes	26.23 minutes
2009	34.00 minutes	34.00 minutes

C. Airport Ground Support Equipment

Airport ground support equipment (GSE) comprises pieces of equipment that service planes between operations. Some examples of GSE are: fuel trucks, baggage tractors, lavatory trucks, and cargo loaders. Aircraft GSE was assigned to the aircraft based on the size and functionality of the aircraft type, which can be thought of as a classification. The five different classifications of aircraft for describing the types of GSE associated with that classification are: narrow-body passenger, wide-body passenger, narrow-body cargo, wide-body cargo and commuter aircraft. General aviation aircraft were assigned no GSE unless a default GSE assignment for a general aviation aircraft existed in EDMS.

GSE assignment and the time of operation for individual pieces of equipment per LTO were the same as used in the Runway 17-35 Extension Project Environmental Impact Statement, developed during a GSE survey conducted at PHL. Although some GSE is powered by gasoline, EDMS does not output emissions based on the type of fuel used. Therefore, all GSE emissions were combined in the source classification code in the SIP that pertains to diesel fuel, 2270008005, since most GSE emissions are produced by diesel-powered equipment.

D. Auxiliary Power Units

An auxiliary power unit (APU) is a gas turbine engine used by many commercial jet aircraft to start the main jet engines, to provide electrical power, and to power the onboard air conditioning (heating and cooling) system. The pilot of an arriving aircraft can shut down the main engines and operate an onboard APU to generate power and to condition the air. When parked at a gate, an aircraft can instead use could 400 Hz electrical power from a mobile ground power unit or receive electrical power and pre-conditioned air from connections at the gate. Using ground-based power instead of an APU greatly reduces air emissions and energy consumption.

An onsite Terminal Gate Survey was conducted on April 5 and April 6, 2004 at PHL to determine which passenger gates have 400 Hz electrical power. Every gate in Terminal A through F at PHL was visually inspected to determine whether the gates have 400 Hz power connection, a pre-conditioned air connection, or both. Approximately 83 percent of the gates at PHL had 400 Hz power in 2004. According to FAA guidance, aircraft that use gates that have 400 Hz power use their APU 7 minutes on average, which is required to be inputted into EDMS. The EDMS default time for an aircraft to use APU power at the gate is 26 minutes. The average time an APU was used at PHL in 2004 is described by the following calculation, (0.83 * 7 minutes) + (0.17 * 26 minutes) = 10.23 minutes. For all aircraft that have APU installed in the EDMS model, 10.23 minutes was assumed to be the average time that the APU was operated at PHL in 2004 and beyond. The APU usage was estimated to be 10.23 minutes per LTO in the 2009 inventory for all aircraft that use APUs.

The Terminal Gate Survey occurred after the 13 gates of Terminal A were brought into operation in 2003. All 13 gates at Terminal A have the capability of supplying 400 Hz power and pre-conditioned air. For the 2002 baseline emissions, the absence of Terminal A gates was taken into account. The average time an APU was used at PHL in 2002 is described by the following calculation, (0.79 * 7 minutes) + (0.21 * 26 minutes) = 10.99 minutes. The APU usage was estimated to be 10.99 minutes per LTO in the 2002 inventory for all aircraft that use APUs.

The fuel used in APU was assumed to be jet fuel. APU emissions were classified in the SIP under their own source classification code, 2275070000 and the type of fuel is described as "other." The Department assumed that the number of gates offering electrical power would not change until 2009.

E. Highway Vehicles

Michael Baker Jr. Inc developed a motor vehicle emissions inventory at the airport. Highway vehicles emissions on the airport property are not included in the highway vehicle inventory in Appendix E. Baker produced the following emissions inventories for the airport section of the SIP.

- 2002 average annual day and annual estimates
- 2002 summer weekday
- 2008 summer weekday
- 2009 summer weekday

1. Overview of Vehicular Traffic Included in Analysis

The on-road vehicle traffic associated with the airport was determined from the memos provided to Baker by DEP. Table 1 summarizes the two on-road categories and the associated vehicle types included in the emissions analysis.

Table 2: Summary of Vehicles Included in Analysis

Vehicles That Access Airport Terminals	Vehicles That Do Not Typically Leave the Airport
• Passenger Car (Drop-Off, Pick Up, Employee Parking, Passenger Parking) • Courtesy Vehicles (Hotel Van, Park & Ride, Rental Car Bus, Shared Ride, Employee Parking Bus, Economy Parking Bus) • Taxi • Limousine • Delivery / Service Vehicles • Rental Cars • Public Transportation (Bus, R-1)	• Rental Car Buses • Employee Buses • Long Term Parking Buses • Airport Service Vehicle Fleet

For each vehicle type, activity data was required to estimate emissions. The activity data was determined from provided memos, and where data was not available, assumptions were applied as documented in the emission calculation spreadsheets. Activity data included the following:

- Number of vehicles
- Distance of route through airport
- Travel distance within parking lots/garage
- Typical travel speeds
- Number of hot and cold starts
- Idling at entry & exit of parking facilities

- Curbside dwell times
- Signal light delays (Number of signals and typical delay times)

All provided activity data was for a 2002 average annual day. For emission calculations, the activity data was adjusted to reflect a typical summer weekday in 2002, 2008, and 2009. Based on the March 12, 2007 memo from Jacobs Consultancy, a scaling factor of 9.3% was used to adjust the vehicular traffic counts to a summer weekday. The memo also provided an estimated growth rate of 43.9% to estimate 2009 on-road vehicular traffic for transportation modes that are expected to increase proportionate to passenger activity levels. Together the growth rate and seasonal adjustments result in an adjustment percentage of 57.2% for 2009. Based on that number, the growth for 2008 was interpolated to be 50.4%.

The provided growth rates were determined from historical and projected growth in annual enplaned passengers at the airport. The growth percentages were applied directly to passenger cars, taxis, limousines, rental cars, deliver vehicles, and airport service vehicle fleets. However, an alternative approach was applied to all airport-related buses. It was assumed that although passengers may grow by 43.9% between 2002 and 2009, buses grow at a slower pace since they may currently have some capacity to handle more passengers and associated business models do not increase activity proportionate to an increase in enplaned passengers. For the 2009 inventory, the average bus level was expected to be only 30% greater than the level in 2002.

2. Emission Calculation Methodology

The emissions were calculated using EPA's MOBILE6.2 emission model, which generates mobile source emission factors. The vehicle categories described above were mapped to the MOBILE6.2 vehicle classes. The 2002, 2008, and 2009 emission factors were calculated for each vehicle class for the following emission types:

- Exhaust running emissions
- Cold-start emissions
- Hot-start emissions
- Idling emissions

Exhaust running emission factors were calculated to account for emissions resulting from vehicle travel within the airport and within the parking lot/garage. The emission factors were calculated using assumed speeds of 20 mph for in-airport travel and 10 mph for travel within parking garages/lots. MOBILE6.2 produces exhaust emission factors in grams/mile. Total emissions were calculated for all the vehicle categories by multiplying the emission factors by vehicle miles of travel (number of vehicles * distance) based on the analysis assumptions.

Hot and cold-start emissions are calculated to account for emissions resulting from the total number of vehicle starts occurring within the airport vicinity. The factors were obtained through separate MOBILE6.2 runs. The output emission factors in grams/mile were converted to grams/start using MOBILE6.2 assumptions. The total start emissions were then calculated by multiplying the grams/start emissions by the total number of starts per day (number of vehicles * number of starts).

Idling emissions were calculated to account for emissions resulting from vehicles idling at the airport. The factors, expressed in grams/hour were obtained by multiplying the running emission rates (grams/mile) for 2.5 mph by 2.5 mph as documented in EPA's January 2002, *Policy Guidance on the Use of MOBILE6 for SIP Development and Transportation Conformity*. These factors were multiplied by the total number of vehicles per day and assumed idling times at garage or lot entry/exit points, curbside dwell, and traffic signals.

The total emissions resulting from each of these emission types were summed to get an estimate of typical summer weekday emissions. Average weekday emissions were also estimated and multiplied by 365 days to obtain an annual estimate in emissions.

F. Nonroad Equipment

Emissions from nonroad equipment emissions, such as construction equipment, during 2002 and 2009 from normal operations at PHL are included in the nonroad inventory for Philadelphia and Delaware Counties and were not included in this appendix. These on-going construction emissions have been associated with capital budgets that ranged from $258 million in 2002 to as little as $56 million in 2005.

The Airport's CEP project is expected to significantly ramp up the level of construction activities to greater than $5 billion of expenditures over a decade. This is also expected to generate substantial construction emissions and result in a temporary increase in emissions from airfield delay. However, the CEP is not projected to begin until at least 2010 and these emissions will occur following the forecast attainment year of 2009. The construction emissions that will occur between January 1, 2010 and June 15, 2010 are forecast to be 37.3 tons of NOx.

G. Point Sources

There are 21 stationary sources of emissions at PHL. Many of these sources have the potential of using many different types of fuels. Philadelphia Air Management Services (AMS) provided to the Department 2002 emissions produced by these sources while using specific fuels as shown by individual source classification codes (SCC). Most of these sources are boilers, generators and space heaters. The airport self reports emissions of these sources to Philadelphia Air Management Services. The Department applied growth factors to the 2002 emissions to obtain 2009 emission levels. Growth factors for point sources were obtained from the Environmental Protection Agency's Economic Growth Analysis System. Point source emissions are included in the regional point source inventory, and also identified in this appendix.

Table 3: Point Sources at PHL

Source Number	SCC	Source Name	Growth Factors (2002-2009)
001	10300501	YORK-SHIPLEY BOILER #1	1.07306
001	10300602	YORK-SHIPLEY BOILER #1	1.01055
002	10300501	YORK-SHIPLEY BOILER #2	1.07306
002	10300602	YORK-SHIPLEY BOILER #2	1.01055
003	10300501	YORK-SHIPLEY BOILER #3	1.07306
003	10300602	YORK-SHIPLEY BOILER #3	1.01055
004	10300501	KEWANEE BOILER #1	1.07306
004	10300602	KEWANEE BOILER #1	1.01055
005	10300501	KEWANEE BOILER #2	1.07306
005	10300602	KEWANEE BOILER #2	1.01055
006	10300501	WELL MCCLAIN BOILER #1	1.07306
006	10301002	WELL MCCLAIN BOILER #1	1.04706
006	10300601	WELL MCCLAIN BOILER #1	1.01055
007	10300501	WELL MCCLAIN BOILER #2	1.07306
007	10300601	WELL MCCLAIN BOILER #2	1.01055
008	10300501	WELL MCCLAIN BOILER #3	1.07306
008	10300601	WELL MCCLAIN BOILER #3	1.01055
009	10300501	MAINT. BLDG. BOILER #1	1.07306
009	10300601	MAINT. BLDG. BOILER #1	1.01055
010	10300501	MAINT. BLDG. BOILER #2	1.07306
010	10300601	MAINT. BLDG. BOILER #2	1.01055
011	10301002	AMERICAN STAND. BOILER #1	1.04706
011	10300602	AMERICAN STAND. BOILER #1	1.01055
012	20300102	EMERGENCY GENERATOR 1-GB	1.07306
013	20300102	EMERGENCY GENERATOR 2-GB	1.07306
014	20300102	CATERPILLAR GENERATOR 3	1.07306
015	20300102	OBRIEN EMERGENCY GEN. 1	1.07306
016	20300102	CATERPILLAR GEN. #4	1.07306
017	20300102	DETROIT DIESEL GEN. 1	1.07306
018	10500106	GENERAC GENERATOR 1	1.05459
019	10500106	MISCELLANEOUS HEATERS	1.05459
020	10500106	MISCELL. RESIDENTIAL HEAT	1.05459
021	10300501	CLEAVER BROOKS BOILER STP	1.07306
021	10300601	CLEAVER BROOKS BOILER STP	1.01055

H. Area Sources

Many different types of area sources exist at PHL, nevertheless, the total emissions from these sources are not very significant. Primary area sources include: fuel storage and transport, solvent use, waste management, painting operations, light industrial and commercial sources, and agriculture and miscellaneous area sources. Types of pollutants produced by area sources at the airport are primarily either VOC or particulate matter. Fuel storage and transport may seem to be a source that would lend itself to high emissions but, aviation fuel, like diesel fuel, is not very volatile and the amount of evaporative emissions produced is negligible. Most area source pollution is produced by solvent use or painting operations and is captured in our regional area source inventory. Area source emissions are included in the regional area source inventory and not included in this appendix.

III. Emissions Summary

Table 4: 2002 Annual PHL Emissions of Ozone Precursors (tons)

	PHL	
Sources of Emissions	**NOx**	**VOC**
Aircraft	1880.6850	310.7000
Ground Support Equipment	242.7254	148.2179
Auxiliary Power Units	28.8735	3.0569
Construction Equipment	---	---
Airport Motor Vehicles	251.5653	43.7012
Area Sources	---	---
Point Sources	13.1479	0.3507

Table 5: 2009 Annual PHL Emissions of Ozone Precursors (tons)

	PHL	
Sources of Emissions	**NOx**	**VOC**
Aircraft	2662.2840	534.9020
Ground Support Equipment	245.8242	189.9705
Auxiliary Power Units	36.7881	3.2862
Construction Equipment	---	---
Airport Motor Vehicles	169.4140	21.7409
Area Sources	---	---
Point Sources	13.7622	0.3647

Table 6: 2002 Summer Day PHL Emissions of Ozone Precursors (tons)

	PHL	
Sources of Emissions	**NOx**	**VOC**
Aircraft	6.3580	0.9500
Ground Support Equipment	0.6348	0.4540
Auxiliary Power Units	0.0849	0.0055
Construction Equipment	---	---
Airport Motor Vehicles	0.7025	0.1269
Area Sources	---	---
Point Sources	0.0360	0.0010

Table 7: 2009 Summer Day PHL Emissions of Ozone Precursors (tons)

	PHL	
Sources of Emissions	**NOx**	**VOC**
Aircraft	9.1280	1.5630
Ground Support Equipment	0.7097	0.5631
Auxiliary Power Units	0.1058	0.0077
Construction Equipment	---	--
Airport Motor Vehicles	0.4730	0.0636
Area Sources	---	---
Point Sources	0.0377	0.0010

IV. Northeast Philadelphia Airport

Methodology and Emissions Summary

The City of Philadelphia also manages the Northeast Philadelphia Airport (PNE). PNE emissions are also included in the SIP. PNE is the city's general aviation reliever and is located approximately 15 miles north of PHL.

Total annual aircraft operations were based on the operations contained in the FAAs Terminal Area Forecast (TAF). The TAF is the official forecast of aviation activity at FAA facilities. The TAF includes historic and projected aircraft operations at PNE. The forecast is an unconstrained demand forecast. It is not dependent on the assumed availability of airport capacity. Types of aircraft using PNE in 2004 were predicted using the City of Philadelphia NOMS. The percentage that certain aircraft type used the airport in 2004 was carried directly forward to 2009. Total operations by aircraft type were apportioned to the total operations in 2002 and 2009 as predicted by the TAF. Operations data was inputted into EDMS similarly as described above for PHL.

Table 8: 2002 Annual PNE Emissions of Ozone Precursors (tons)

	PNE	
Sources of Emissions	**NOx**	**VOC**
Aircraft	41.7620	68.0470
Ground Support Equipment	24.5958	20.0443
Auxiliary Power Units	1.2960	0.0209

Table 9: 2009 Annual PNE Emissions of Ozone Precursors (tons)

	PNE	
Sources of Emissions	**NOx**	**VOC**
Aircraft	32.9580	55.9810
Ground Support Equipment	15.6209	14.7481
Auxiliary Power Units	0.9775	0.0154

Table 10: 2002 Summer Day PNE Emissions of Ozone Precursors (tons)

	PNE	
Sources of Emissions	**NOx**	**VOC**
Aircraft	0.1144	0.1864
Ground Support Equipment	0.0674	0.0549
Auxiliary Power Units	0.0036	0.0001

Table 11: 2009 Summer Day PNE Emissions of Ozone Precursors (tons)

	PNE	
Sources of Emissions	**NOx**	**VOC**
Aircraft	0.0903	0.1534
Ground Support Equipment	0.0428	0.0404
Auxiliary Power Units	0.0027	0.0000

COMPARISON OF ACTUAL AND EDMS FLEET MIXES AND ENGINE TYPES
2002 BASELINE ANALYSIS
Philadelphia International Airport

Aircraft	Engine	Total	% of Total Operations	EDMS Engine Type	NOx	Comments
A319	CFM56-5A5	501	2.5%	V2522-A5	0.535	A majority of the A319 engine types operating at PHL in 2002 are not reflected in the EDMS fleet mix.
	CFM56-5B6/P	15,810	78.2%			
	V2522-A5	2,767	13.7%			
	V2524-A5	1,139	5.6%			
A320-211	CFM56-5A1 (A320-211)	445	4.6%	CFM56-5A1	0.240	A majority of the A320 aircraft types (-212, -214, -231, -232) and engine types operating at PHL in 2002 are not reflected in the EDMS fleet mix.
	CFM56-5A3 (A320-212)	661	6.8%			
	CFM56-5B4/P (A320-214)	6,170	63.8%			
	V2500-A1 (A320-231)	839	8.7%			
	V2527-A5 (A320-232)	1,554	16.1%			
B-737-300	CFM56-3B1	16,201	57.6%	CFM56-3B-2	0.515	CFM56-3B1's represent the majority of B-737-300 operations in 2002, but are not reflected in the EDMS fleet mix.
	CFM56-3B2	10,142	36.1%			
	CFM56-3C1	1,773	6.3%			
B-737-400	CFM56-3B2	11,571	100.0%	CFM56-3B-2	0.260	**GOOD**
B-757-200	JT8D-15	62	0.4%	RB211-535E4	0.596	PW2037's are also included in the EDMS fleet mix. Confirm that LTO's assigned to each engine type reflect the actual distribution of operations.
	PW2037	1,965	13.7%			
	PW2040	951	6.6%			
	RB211-535E4	10,445	72.7%			
	RB211-535E4-B	940	6.5%			
Total:		83,935				

Note: Grand Total does not match the grand total in the "AircraftDist.pivot" tab because some airlines' aircraft did not appear in *jpfleets*

EDMS AIRCRAFT RECOMMENDED SUBSTITUTIONS
PHL MASTER PLAN SIP ASSESSMENT

Actual Fleet Mix			EDMS Substitution		
Aircraft	**Actual Engine Type**	**EDMS Engine Type (1)**	**Aircraft**	**Actual Engine Type**	**EDMS Engine Type**
Lear 45	Honeywell TFE731-20-AR	TFE731-3	**Citation VII**	Honeywell TFE731-4R-2S	TFE731-3
Lear 55	Honeywell TFE731-3A-2B	TFE731-3	**IAI 1124 Westwind**	Honeywell TFE731-1100G	TFE731-3
Lear 60	Pratt & Whitney PW305A (4)	?	**Citation Sovereign** Falcon 20	**Pratt & Whitney PW306C** Honeywell TFE731-5BR-2AC	**PW308C** TFE731-3
MU-2 Marquise	Honeywell TPE331-10-501M	TPE331-10	**Cessna 441 Conquest2** **Jetstream 31**	**Honeywell TPE331-8-410S/402S** **Honeywell TPE331-10**	**TPE331-8** **TPE331-10**
B58 Baron	Teledyne Continental IO-550C	?	**Navajo** Cessna T337	**Lycoming TIO-540-A** Continental IO-360-C	**TIO-540-J2B2** IO-360-B

Notes:
(1) EDMS engine type for actual fleet mix not present in EDMS model are derived from "Appendix F: Engine Mappings" of the SAGE Version 1.5 Technical Manual
(2) EDMS engine types for aircraft in the EDMS model are taken directly from EDMS model.

Sources:
airliners.net / The International Directory of Civil Aircraft
SAGE Version 1.5 Technical Manual: Appendix F
Bombardier Learjet 45 General Specifications
Bombardier Learjet 60XR General Specifications
Cessna Citation Sovereign General Specifications
Dassault Falcon 2000EX Specifications